REMARKS

This amendment is responsive to the first Office Action dated August 24, 2004. Applicants respectfully request reconsideration and allowance of claims 1-4 and 6-13 as set forth herein.

The current status of the claims

Claims 1-12 stand rejected under 35 U.S.C. § 103(a) as being unpatentable over Yamada et al. (U.S. 5,394,256, hereinafter "Yamada") in view of Borza et al. (U.S. 6,215,874, hereinafter "Borza") and Dennin et al., "Patterns of Electroconvection in Nematic Liquid Crystal" (hereinafter "Dennin").

Supplemental Information Disclosure Statement

Applicants submit herewith a supplemental information disclosure statement (IDS) containing the single reference: Kai et al., *Supplements to Progress in Theoretical Physics*, v. 64, pp. 212-43 (1978) which is cited at ¶[0044] of the application. As this supplemental IDS is being submitted within the timeframe set forth in 37 C.F.R. § 1.97(c) along with the fee set forth in 37 C.F.R. § 1.17(p), Applicants respectfully request an indication of receipt and consideration of this reference in the forthcoming Office Action.

Claims 1-4, 6, and 13 patentably distinguish over the references

Claim 1 has been amended to incorporate subject matter of canceled dependent claim 5 and to clarify the relationship between the applying of the potential difference, turbulence resulting from the potential difference, and the measuring of at least one physical property affected by the turbulence. Additionally, new dependent claim 13 is added, and is supported in the original specification at least at ¶[0033].

Claim 1 calls applying a potential difference across electrodes of a liquid crystal effective to produce turbulence in

the liquid crystal material, and measuring at least one physical property of the liquid crystal material to generate a plurality of reading measurements. The at least one physical property is affected by the turbulence of the liquid crystal material. Bits are set based on said plurality of reading measurements to generate a sequence of random numbers.

Yamada merely discloses a specific type of liquid crystal cell. Applicants readily acknowledge that liquid crystal cells are well known in the art. However, there is no suggestion in Yamada to produce turbulence in a liquid crystal, or to measure a property affected by such turbulence, or to generate random numbers from such measurements. Indeed, Yamada does not even address random number generation.

Borza cannot remedy this deficiency in Yamada, because Borza also does not disclose or fairly suggest generating random numbers using a liquid crystal. Indeed, Borza nowhere mentions the term "liquid crystal" (or even "liquid") or "LCD" (or even "LC") anywhere. Borza does not generate random numbers based on turbulence; indeed, the words "turbulence" and "chaos" are never mentioned in Borza.

Dennin cannot remedy these deficiencies of Yamada and Borza. Rather than motivating the skilled artisan toward the method of claim 1, Dennin actually teaches away from that method by disclosing non-random patterns in electroconvective flow in liquid crystals. Dennin Figs. 4, 9, 10, 12, and 13 show highly ordered patterns and correspondingly ordered Fourier patterns. These highly ordered, non-random patterns are not suitable for generating random numbers.

Dennin Fig. 7 does illustrate a "worm" state which includes a small amount of randomness. While the "worms" of Fig. 7 are clearly ordered, they appear spontaneously "at seemingly random locations." Dennin page 644 col. 1. However, even this "worm" state is actually highly ordered and non-random. Parts (a), (b), (c), (d) of Fig. 7 were taken at 60 sec. increments. Over this four minute period of time, the "worms" are seen to be relatively

stationary, at most inching along slowly in the horizontal direction. (Dennin Fig. 7 caption and p. 644 text). Indeed, once a worm forms, it is stable and does not disappear unless it travels all the way to the edge of the liquid crystal cell. (Dennin p. 655 near bottom of 1st col). Again, such a non-random and substantially temporally constant pattern is unsuitable for use in generating random numbers.

In contrast, the present application applies a relatively larger electrical bias versus Dennin, which is effective to produce turbulence in the liquid crystal material, as called for in claim 1. This turbulence is highly non-linear in that very many spatial and temporal Fourier modes are strongly coupled and continually mixing, producing flow fields that are unpredictable. (Present application at ¶[0024]; see also Fig. 5 which as noted at ¶[0048] shows no visible structure, indicating a truly random sequence). At least one physical property of the liquid crystal material affected by the turbulence is measured, and a sequence of random numbers is generated based on these measurements. Nothing in Yamada, Borza, or Dennin suggests a method including generating turbulence in a liquid crystal and generating random numbers based on such turbulence.

For at least these reasons, it is respectfully submitted that claims 1-4, 6, and 13 as set forth herein patentably distinguish over the references. Accordingly, Applicants respectfully ask for allowance of claims 1-4, 6, and 13 as set forth herein.

Applicants request reconsideration and allowance of claims 7-9

Claim 7 calls for a pair of opposed substrates containing a layer of liquid crystal therebetween, with each substrate having an electrode facing the other substrate. A power supply applies an electric potential across the electrodes to drive the liquid crystal into a chaotic flow. At least one device measures a physical property of the layer of liquid crystal which generates physical property measurements after an electric potential is

applied. An interface communicating with the device measures and digitizes a physical property to generate a random number.

Yamada has nothing to do with generating random numbers. Borza generates random numbers, but in a completely different manner from the apparatus of claim 7. The random number generators of Borza do not employ either a chaotic flow or a liquid crystal. Dennin merely presents a scientific study of liquid crystal cells showing formation of non-random ordered patterns in electroconvective flow.

In summary, none of Yamada, Borza, or Dennin disclose an apparatus measuring a physical property of a liquid crystal material undergoing chaotic flow and generating digitized random numbers from those measurements.

For at least these reasons, it is respectfully submitted that the rejections of claims 7-9 based on the combination of Yamada, Borza, and Dennin should be withdrawn. There being no other basis set forth in the Office Action for rejecting these claims, Applicants therefore respectfully ask for allowance of claims 7-9.

Claims 10-12 patentably distinguish over the references

Claim 10 calls for applying an electrical stimulus to a liquid crystal cell. A turbulent flow of liquid crystal contained in the liquid crystal cell is produced by the applied electrical stimulus. At least one physical property of the turbulently flowing liquid crystal is measured to generate a baseline measurement. A plurality of bits are set based on said baseline measurement so as to generate a sequence of random numbers. The sequence of random numbers is used to generate an encryption key.

None of the references, alone or in combination, disclose or fairly suggest a method including producing a turbulent flow in a liquid crystal, measuring at least one physical property of the turbulently flowing liquid crystal, and generating a sequence of random numbers from these measurements.

Only one of the applied references, namely Borza, even relates to generating random numbers, and Borza uses a completely different method that does not involve either liquid crystal or turbulent flow. Yamada merely informs the skilled artisan that liquid crystal materials exist - it does not motivate the skilled artisan to use liquid crystal to generate random numbers. Dennin actually teaches away from such a use of liquid crystal, by showing liquid crystals under electrical bias producing non-random patterns that are not suitable for use in generating random numbers.

For at least these reasons, it is respectfully submitted that claims 10-12 as set forth herein patentably distinguish over the references. Accordingly, Applicants respectfully ask for allowance of claims 10-12 as set forth herein.

CONCLUSION

In view of the foregoing amendments and remarks, it is respectfully submitted that all claims 1-4 and 6-13 as set forth herein are now in condition for allowance. Accordingly, Applicants respectfully ask for allowance of claims 1-4 and 6-13 as set forth herein.

Respectfully submitted,

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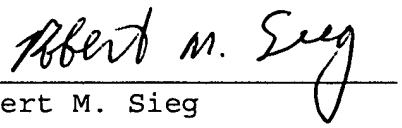

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